# 194.077 Applied Deep Learning
# Assignment 1 - Weather Phenomena Classification

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## Contents

# 1 Introduction

In the persistently evolving field of Machine Learning, Computer Vision has gained enormous popularity thanks to its ability to interpret visual information in a meaningful way. In the realm of Visual Computing, this project proposes an Image Classification task using Deep Learning methods on the Weather Phenomena Dataset (WEAPD [1]) to classify diverse weather phenomena.

# 2 Dataset

The dataset comprises 6862 photos, with 11 classes: dew, fog/smog, frost, glaze, hail, lightning, rain, rainbow, rime, sandstorm and snow. This dataset includes a higher number of classes compared to other traditional weather classification datasets. The class with the most samples is 'rime', with 1160 images, by contrast, 'rainbow' accounts for only 238 images, making this an imbalanced dataset. To deal with this shortcoming techniques such as data augmentation must be adopted. All samples are color images in JPG format that vary in size.

# 3 Related Works

In image classification tasks, transfer learning is commonly applied, this is particularly useful in solving the problem of insufficient training data. Some of the best results achieved on this dataset leverage the VGG16 architecture.
The authors of the WEAPD dataset explain their approach for Weather Classification in the 2021 paper '*Classification of Weather Phenomenon From Images by Using Deep Convolutional Neural Network* [2]'. They introduce the MeteCNN architecture, a modified version of the VGG16 architecture, which achieves impressive performance with 92.68% accuracy. This architecture includes improvements like the use of Squeeze-and-Excitation (SE) modules and dilated convolutions. A more recent paper published in 2024, '*Enhanced Multi-Class Weather Image Classification Using Data Augmentation and Dynamic Learning on Pre-Trained Deep Neural Net* [3]' uses transfer learning to achieve comparable results. They employ data augmentation techniques and fine-tuning to obtain 92.10% accuracy.

# 4 Project Idea (Bring your own Method)

This project falls into the 'Bring your own method' type for this Assignment: it uses a pre-existing dataset and model, aiming to modify its architecture and achieve performance improvements.

**Objectives:**

- **Expand the number of weather phenomena** classes by gathering additional data samples, as suggested by the dataset's authors for future works.
- **Explore additional data augmentation techniques** to address the data shortage for some classes.
- **Re-implement the MeteCNN or VGG-16 models**, experimenting with modifications in the architecture, or fine-tuning the last layers (this will be assessed

based on the computational feasibility of the training task), changing parameters such as learning rate, batch size, dropout, and experimenting with the loss function.

## 5 Work-Breakdown

The development pipeline consists of the following steps:

- **Dataset Retrieval and Scientific Paper Research**: 3-4 hours
- **Data Preprocessing, Model Development and Training**: 15-20 hours
- **Model Improvements and Fine-Tuning**: 15-20 hours
- **Final Testing and Evaluation**: 1-2 hours
- **Report and Results Presentation**: 6-8 hours

## References


[1] H. Xiao, "Weather phenomenon database (WEAPD)," 2021. [Online]. Available: https://doi.org/10.7910/DVN/M8JQCR

[2] H. Xiao, F. Zhang, Z. Shen, K. Wu, and J. Zhang, "Classification of weather phenomenon from images by using deep convolutional neural network," *Earth and Space Science*, vol. 8, 05 2021.

[3] D. Chattoraj, A. Chatterjee, S. Ghosh, A. Ghosh, and E. Ientilucci, "Enhanced multi-class weather image classification using data augmentation and dynamic learning on pre-trained deep neural net," 08 2024, pp. 459–464.